A PUTTING STROKE ANALYZER
AND A PUTTER FOR USE THEREIN

FIELD OF THE INVENTION

The present invention relates to an apparatus to contribute to enhancement of skill of a player oneself of guidance of the player and to selection of a putter optimal to the player by analyzing a putting stroke of golf, and a putter for use therein.

BACKGROUND OF THE INVENTION

Especially, a skilled golf player makes much account of a putting since it has an effect on the score. However there are a few ranges to practice easily and there is no way to analyze and evaluate the sensitive stroke objectively even if there is a range. Therefore the only way to improve the putting skill is to practice over and over again spending time and energy. On the other hand, it is difficult for an instructor to give a proper advice based on objective data.

One of inventors of the present invention is a professional coach authorized by the Japan Driving Range and also prosecutes to make putters to fit an individual player. He has provided handmade putters which have all kinds of different elements respectively such as shape, weight, length, lie angle (angle between ground and shaft), loft angle (an angle between sole and face of the putter), goose angle (an angle between ground and bump), appearance of putter face, an aiming line (a line to indicate aiming direction marked on a putter head) to fit somatotypes, requests, images of a variety of professional players.

In this case, the above putters provided to fit the individual player are not always the best ones since there is no way to analyze and evaluate the players' stroke accurately and objectively.

Conventionally, the common way to judge the skill of putting stroke was to judge from the actual rolling way of a ball on the putting green of golf course or the training mat made of artificial turf.

Recently, the unexamined utility model application No.06-81567 discloses a training

equipment to estimate the rolling distance, and the unexamined patent application No.2000-102633 discloses a training equipment to estimate not only the rolling distance but also the rolling direction, by detecting movement of the ball rolling between two points using an optical sensor in order to be able to practice at narrow area without checking the rolling way of the ball to the end.

However these inventions are to judge putting condition by checking the movement of the ball and they can not evaluate the putting stroke itself to cause the movement of the ball.

The training equipments for evaluating the putting stroke by detecting the movement of the putter head using the optical sensor and the like are put on the market such as "Putting Checker" of Miyamae incorporated (Higashi-Osaka city) and "Putting Machine" of Sword Technica (Kawasaki city).

The former arranges plural pairs of some sensors put across the training mat in the direction of the stroke to detect light reflected from the putter head stroked on the mat to analyze and indicate track of the putter head, slope of the aiming direction of the putting face, head speed and the like by detection of light reflected from each sensor and time difference of the reflected light.

The latter detects laser light reflected from the putting face by optical sensors to grasp movement of the putter head by several pairs of magnetic sensors arranged on the training mat for putting stroke to analyze and display slope of the aiming direction of the face, the head speed and the like.

However the above equipments can only detect the movement of the putter head roughly since they analyze data input from limited number of sensors by a calculator to display the result and have limited accuracy because the input data don't have continuity.

The sorts of data to be able to display as the analyzed result and timing during the stroke to be able to display are limited since the input data are limited. For example, in the case to display the direction of the face, they display only at the predetermined limited timing such as the direction at the time of aiming or impacting.

In order to know and correct the putting stroke of a player oneself as necessary to rise the probability to drop a ball in a cup greatly, it is much effective to provide an apparatus to

measure and analyze, evaluate the putting stroke, namely the direction of the face, the track of the head (including sweet spot at the time of impact and shift in the both directions of toe (tip side from the player's view) / heel (this side from one's view) of hitting point during from the aiming decided by the player at the beginning of the stroke, take away stroke at the time of prestroke, forward stroke for hitting the ball, impact, to follow through stroke after impact, and head speed, and display the result.

And also it is possible to give a proper advice based on the objective data to improve the putting skill if the apparatus is available to analyze and evaluate the putting stroke to display the result with a sufficient accuracy.

Furthermore if there is such an apparatus at the golf shop, it is very helpful to select a proper putter for a customer since he or she can evaluate the putting stroke of oneself at the time of using of the putter easily and objectively by stroking with the putter using the apparatus.

The object of the present invention is to provide means to be able to analyze and evaluate all kinds of data such as the direction of the face, the track of the head, and the speed of the head at any timing during stroke with a sufficient accuracy to meet the need of the player by analyzing data to indicate the movement of the putter head during the putting stroke continuously.

SUMMARY OF THE INVENTION

The present invention analyzes movement of the putter head in the putting stroke of golf continuously with a sufficient accuracy by using position detecting method through electromagnetic induction.

First of all the position detecting method through electromagnetic induction will be described.

On the position detecting mat, a plurality of exciting coils $X1, X2, X3 \cdots, Xn$ extending in the X axis direction are arranged in parallel horizontally, and also a plurality of exciting coils $Y1, Y2, Y3 \cdots, Ym$ extending in the Y axis direction are arranged in parallel horizontally, as shown on the Fig. 8. A constant frequency signal is sent from an exciting and

detecting apparatus to these coils one and after.

On the other hand, electromagnetic resonators 24 which is an LC resonance circuit combined capacitance with inductance selected to resonate to the frequency are set on the side detected position, on the putter head (not shown) in this case, so that the surface of the inductor can parallel to the surface of the mat.

For example, once the signal is sent from the exciting and detecting apparatus 35 to the coil X2, magnetic line of force that the strength changes in response to the frequency generate in the coil X2, and a part of the magnetic line of force pass through the inductor of the electromagnetic resonators. The current having the same frequency flows in the electromagnetic resonators according to Faraday's law relating to the electromagnetic induction because the magnetic line of force passing through changes in response to the frequency. The coil X2 serves as an exciting coil in this case.

The current flowing in the electromagnetic resonators 24 is larger if the electromagnetic resonators are close to the coil X2, and they are smaller if they are far from that. Because the magnetic line of force generated hardly ever pass through the inductor of electromagnetic resonators since the magnetic line of force generating from the coil X2 set horizontally faces to the perpendicular direction approximately when the position of the electromagnetic resonators deviates from the coil X2.

When the current flows in the electromagnetic resonators 24 through electromagnetic induction, the current generates the magnetic line of force as well. The strength of the magnetic line of force changes at the same frequency as the current flowing in the electromagnetic resonators. The current having the same frequency flows in the coil according to Faraday's law because the magnetic line of force that the strength changes passes through the coil arranged on the position detecting mat.

The coils on the position detecting mat serve as not only exciting coils but also position detecting antennas. Namely, the exciting and detecting apparatus 35 measure the current generated through the electromagnetic induction in the coils Y1, Y2, Y3, · · · Ym by current flowing the electromagnetic resonators as signals one after another. Likewise, The signals excited in the coils Y1, Y2, Y3, · · · Ym are larger if electromagnetic resonators 24 are close

to the coil, and they are smaller if they are far from that. Because the magnetic line of force generated at the electromagnetic resonators hardly ever pass through the coils since the magnetic line of force generating from the inductor of electromagnetic resonators set horizontally faces to the perpendicular direction approximately when the position of the electromagnetic resonators deviates from the coil.

Every time the exciting operation is repeated at X1, X2, X3, $\cdot$ $\cdot$ $\cdot$ one after another, the detection operation is repeated at Y1, Y2, Y3, $\cdot$ $\cdot$ $\cdot$ one after another, and every time the exciting operation is repeated at Y1, Y2, Y3, $\cdot$ $\cdot$ $\cdot$ one after another, the detection operation is repeated at X1, X2, X3, $\cdot$ $\cdot$ $\cdot$ one after another.

The strength S of the detected signal indicates maximum Sa at the position detecting antenna Xa proximate to the electromagnetic resonators, and the strength of the detected signal goes down such as Sa+1, Sa+2, $\cdot$ $\cdot$ $\cdot$, or Sa-1, Sa-2, $\cdot$ $\cdot$ $\cdot$ as the distance from the electromagnetic resonators is longer such as Xa+1, Xa+2, $\cdot$ $\cdot$ $\cdot$, or Xa-1, Xa-2, $\cdot$ $\cdot$ $\cdot$. The point Xm that the strength of signal is a maximum Sxm on a curve Cx tracing these measure points is where the electromagnetic resonators exist.

Likewise, Ym can be sought as a maximum Sym on a curve Cy as shown Fig. 9 (b).

Accordingly, x-y coordinate including the electromagnetic resonators can be easily obtained.

The present invention is an apparatus to detect a signal generated in a position detecting antenna through electromagnetic induction between an exciting coil generated by stroking a putter having a head added with electromagnetic resonators of an LC resonance circuit having inductance and capacitance and electromagnetic resonators, and between electromagnetic resonators and the position detecting antenna, above position detecting mats having a plurality of exciting coils also serving as the position detecting antenna extending, respectively, in X axis direction and Y axis direction.

The player strokes a putter having a head partially added with electromagnetic resonators above the position detecting mats having exciting coils also serving as the position detecting antennas.

It is not always required to put a golf ball on the position detecting mat, and it is only

required to mark the position of the ball. Further means for indicating the direction of a cup position for aiming will be required.

When the player strokes to the cup position assuming that the mark on the position detecting mat is the golf ball, the x-y coordinate having electromagnetic resonators added with the putter is measured instantly and continuously by the position detecting method using the above electromagnetic induction.

The apparatus analyzes the x-y coordinate on each measured time and display the result by value or images to provide efficient data for a player to aim enhancement of putting skill and a trainer to coach for the enhancement, such as the track of patter head and head speed in the stroke, and sweet spot at the time of impact and shift in the both directions of toe / heel, rolling distance to be able to estimate from head speed at the time of impact instantly and with a sufficient accuracy. It can indicate valuation of the putting stroke based on those data. It is very effective for selecting the best putter for one to obtain these data instantly as mentioned above.

The analyzing method can provide all kinds of data including value of any timing in the stroke but not limited to the above data to meet the player's need, since it is possible to grasp data indicating movement of the putter head in the putting stroke by using the position detecting method through electromagnetic induction.

According to experiment using a mat that comprises exciting coils also serving as the position detecting antennas to arrange wires extending respectively in the X axis direction and Y axis direction at 5 mm distance to connect as shown Fig. 8, it was easy to detect position of electromagnetic resonators with accuracy below 0.1 mm. The detecting speed was enough to grasp movement of head in putting continuously since the position detecting can be done instantly.

Furthermore, it is possible to detect position of electromagnetic resonators added with the putter head when the player strokes a putter on the mat commonly since it is possible to detect the position even if the electromagnetic resonators locates at 20 to 30 mm above the mat.

The electromagnetic resonators for use therein can be installed at the normal putter head

with little obstruction to putting stroke because it can be configured to cylinder shape below 8mm diameter and 15mm height. And has proper size to install at the putter head.

The present invention is the above apparatus to detect signals generated in a position detecting antenna individually through electromagnetic induction acted by each electromagnetic resonator to analyze the putting stroke, using a putter added with two electromagnetic resonators comprising one at toe side (tip side viewed from a player) of the head and another at heel side (this side of the head).

It is possible to analyze not only position of the whole head but also an angle to the aiming direction of the head face (including an angle of the face at the time of impact) continuously with a sufficient accuracy by measuring and analyzing the x-y coordinate of two electromagnetic resonators installed at the head on each time individually. Of course it is easy to display an angle of the face not only at the time of aiming and impacting but also at any timing in the stroke in response to the player's need.

These are also useful data for a player aiming enhancement of skill and a trainer coaching for the enhancement and very helpful to select the best putter for oneself since the difference between aiming line inscribed on the upper face of putter head to indicate the direction and feeling of the player oneself having the putter is clear.

Furthermore, the present invention is the above apparatus characterized by detecting signals generated in a position detecting antenna individually through electromagnetic induction acted by each electromagnetic resonator, setting two pairs of independent position detecting mat adjacently at the both sides of stroking line of the head at the time of using a putter added with one electromagnetic resonator on each side of toe and heel of the head.

As mentioned above, the position detecting method through electromagnetic induction detects a signal generated in a position detecting antenna through electromagnetic induction between exciting coils and electromagnetic resonators, and between the electromagnetic resonators and the position detecting antenna to measure x-y coordinate of the electromagnetic resonators. Therefore, the above method sometimes can not grasp the x-y coordinate with accuracy because of measurement by adding signals acted by each electromagnetic resonator if two electromagnetic resonators exciting at the same frequency

are existed closely.

It causes a little damage if two electromagnetic resonators separate from each other at a distance since magnetic line of force generated from exciting coils and electromagnetic resonators faces toward perpendicular direction.

In that case, it is better to detect signals generated in the position detecting antenna individually through electromagnetic induction acted by each electromagnetic resonator, setting two pairs of independent position detecting mat adjacently at the both of this side and that side viewed from a player of stroking line of the head in order to prevent from disturbance by existence of other electromagnetic resonator.

The electromagnetic resonator at the heel side is measured on the position detecting mat at this side of stroking line since two electromagnetic at the toe side and the heel side of putter head resonators are set at a distance from each other.

The same effect as the above can be obtained by using a pair of position detecting mat to make the exciting coils also serving as position detecting antennas work separately at this side and that side of stroking line of head instead of setting two pairs of mats independently at the both sides of stroking line of the head.

Namely, the same effect as the above case setting two pairs of position detecting mats can be obtained if the exciting coils also serving as the position detecting antennas in parallel to the stroking line have two pairs of group at this side and that side of the stroking line of the head and another group is not exciting when one group is exciting or another group is controlled not to detect by exciting and detecting apparatus when one group is detecting.

It is possible to prevent from disturbance of measurement by existence of another electromagnetic resonator to measure x-y coordinate of two electromagnetic resonators with a sufficient accuracy to analyze putting stroke with accuracy, even if any methods are used.

The present invention is a putter added with electromagnetic resonators combined with the above putting stroke analyzing apparatus. The above putting stroke analyzing apparatus can act by using the putter having a head added with electromagnetic resonators.

The putter is preferable to able to remove the electromagnetic resonators added in necessary.

The head added with electromagnetic resonators don't have any effect on playing at the golf course. The player oneself doesn't feel bad by the existence of the electromagnetic resonators or the stranger doesn't have misgivings about effect on playing by the existence, if the electromagnetic resonators are removable if necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a whole view of constitution of preferred putting stroking apparatus according to the present invention;

Fig. 2 is a enlarged view of the putter head part according to the present invention;

Fig. 3 is a front view and a side view of the putter head according to the present invention;

Fig. 4 is a view of the structure of a electromagnetic resonator added to the putter head according to the embodiment of the present invention;

Fig. 5 and fig. 6 are respectively one example of display of the putting stroke analyzing apparatus according to the present invention;

Fig. 7 is a view for explaining connection between the electromagnetic resonators added to the putter head, and sweet spot and face of the head;

Fig. 8 and fig. 9 are respectively a view for explaining the position detecting method through electromagnetic induction;

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference to the drawings the present invention will now be described to be able to understand easily.

Fig. 1 shows a whole view of preferred constitution of the putting stroking apparatus according to the present invention. The player 1 takes address position on the training mat 3 set two pairs of position detecting mats 3a, 3b having exciting coils also serving as position detecting antenna with the putter 2 having a head added with electromagnetic resonators.

There is a mark indicating position of a ball to be hit on the training mat 3, and laser light 33 radiates from laser beam radiating apparatus 32 and irradiates an object such as wall

and the like so that indication 34 can come out in the direction of a cup for aiming.

Exciting and detecting apparatus 35a, 35b are set on the position detecting mats 3a, 3b, and a constant frequency of signal is sent to the exciting coils also serving as the position detecting antennas (not shown but correspond to X1, X2, X3, · · · Xn, and Y1, Y2, Y3, · · · Ym,) one after another, or signals excited by the coils are detected one after another.

The detected signals are sent to a calculation 36 including data memory means 36a, operation means 36b, input means 36c, and display means 36d.

Fig. 2 is a enlarged view shown a part of a head 21 of a putter 2 the player 1 hands. Fig. 3 shows a front view (a) and a side view (b) of the head 21.

Two holes 22a, 22b are bored through toe side and heel side of bottom of the head 21 respectively; electromagnetic resonators 24 shown on fig. 4 can be received therein respectively.

An LC resonance circuit comprising an inductor 25a and a capacitor 25b selected to resonate at a constant frequency is included in the electromagnetic resonators 24. A magnetic member 25c is sometimes inserted into the inductor 25a because of dimensional limitation of electromagnetic resonators and resonant frequency. Generally, resin layer 25d coat the LC resonance circuit constructed like this to protect and insulate from exterior.

The electromagnetic resonator 24a is inserted into a hole 22a of the toe side of a head 21 shown on fig. 2 and the electromagnetic resonator 24b is inserted into a hole 22a of the heel side thereof to be fixed.

The player 1 takes address position to put the head 21 on the mark 31 indicating position of the ball to stroke along the aiming line 26 toward the indication 34 of the cup.

The electromagnetic resonators 24a don't deviate from the position detecting mat 3a or the electromagnetic resonators 24b don't deviate from the position detecting mat 3b, as long as the player stroke naturally since the position detecting mat 3a is arranged at that side of the stroking line viewed from the player and the position detecting mat 3b is arranged at that side thereof.

Furthermore, at the experiment using training mats set the position detecting mats 3a and 3b at 10 mm distance, the position detecting mat 3a could detect x-y coordinate of the

electromagnetic resonator 24a and the position detecting mat 3b could detect x-y coordinate of the electromagnetic resonator 24b, without any effect from other electromagnetic resonators.

Data sent from the exciting and detecting apparatuses 35a, 35b to calculator 36 are stored in the memory means 36a and processed at operation means 36b to enhance putting skill of the player oneself such as direction of the face 27, trace of the head in the stroke, deviation between sweet spot 28 and toe / heel direction of the actual hitting point at the time of impact, head speed and the like. Or they are converted into very efficient data to coach for enhancement to be displayed at display means 36d.

Fig. 5 illustrates one example of display by the display means 36d. Fig. 6 illustrates the English version thereof.

These are examples indicating "result" of the whole putting stroke, an angle of the face at the time of aiming, the deviation between a sweet spot and a hitting point, head speed at the time of impact, rolling distance and direction estimated from them. It is possible to be processed by the operation means 36b to display a lot of efficient data outside these data, since x-y coordinate on each time of each electromagnetic resonator 24a, 24b is stored as continuous data. It is also to display a habit of the player's stroke.

Furthermore, two electromagnetic resonators 24a, 24b are set at symmetric position of both sides of aiming line 26 and in parallel to the face 27 at the putter head 21 illustrated in fig. 2 and fig. 3. Therefore, in this case, it is possible to work out the deviation between the sweet spot and toe / heel direction of the actual hitting point at the time of the head, if the deviation in the perpendicular direction of stroke line of both electromagnetic resonators is detected since sweet spot 28 of the head is located at the same distance as two electromagnetic resonators, and also it is possible to work out the direction of the face 27 in stroke, if the difference of passing time in parallel to the stroke line of both electromagnetic resonators is detected.

However, two electromagnetic resonators 24a, 24b can not always be set at symmetric position of both sides of aiming line 26 and in parallel to the face 27.

In that case, the calculator 36 can analyze and display movement of the putter head with

accuracy by inputting positions of two electromagnetic resonators 24a, 24b and the sweet spot, relationship of direction of the face 27, distance La between electromagnetic resonators 24a and sweet a spot 28, distance Lb between the electromagnetic resonator 24b and the sweet spot 28, an angle α between the face 27and La direction, and an angle β between La direction and Lb direction by an input means 36c beforehand.

Furthermore, it is possible to be done works by this input means 36c such as inputting distance to the aiming cup, or setting rolling speed on the putting green, or titling a player's name or date and the like to stroke data.

Fig (b) illustrates a electromagnetic resonator having an external thread 25d around resin layer and a groove 25f to be able to insert a screwdriver into a lower part, namely a part correspond to bottom of the head. The electromagnetic resonators are removable to the putter head quickly and easily if internal threads are made to fit the external threads inside of holes 22a, 22b of the putter head.

The head added with electromagnetic resonators don't have any effect on playing at the golf course. The stranger doesn't have misgivings about effect on playing by the electromagnetic resonators, and they can be removed as soon as someone notices, if they are removable easily as the above. They can be removed before playing, if the player oneself doesn't feel bad by the existence of the electromagnetic resonators at the time of stroke.

Cylindrical resin shaped in the same outline as fig. 4 (b) can be inserted, if holes 22a, 22b bother after removing electromagnetic resonators.

As the above, a putting stroke analyzer and a putter for use therein is very effective as a training apparatus for putting , an apparatus to coach therefore, and also an apparatus to help selecting the best putter for the player.